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ROENTGEN DIAGNOSIS OF GASTRIC CANCER: REPORT OF TWELVE CASES.

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In the detection of cancer of the stomach, the Roentgen rays take precedence over all other methods, despite the fact that "we are only in the daguerreotype stage of Roentgen-ray photography."[1] In the Mayo Clinic, 95 per cent. of gastric carcinomas are discovered by this means, a percentage which is not approached by any other process of examination.

Since nearly one-third of all cancers occur in the stomach, and since early recognition and operation alone afford a chance of cure, any measure which will increase the number of correct and early diagnoses is of the highest importance.

Prior to the development of gastric roentgenology, diagnostic reliance had to be placed upon the history, the physical examination and the gastric analysis. Significant in the history were: middle or advanced age of the patient; digestive disturbance, such as anorexia, vomiting, occasionally pain, hematemesis, etc.; cachexia and loss of weight. By the physical examination the presence of a tumor was sought for. The gastric analysis was scanned for achlorhydria, food remnants, blood, and Oppler-Boas' bacilli.

It is quite clear that the most important of these evidences can result only from a cancer which is well advanced or one which is obstructive. The records of our Clinic show that in a large series of cases confirmed by operation, 67 per cent. of the patients had

[1] Mayo, W. J., The Cancer Problem, Journal-Lancet, 1915, xxxv.

palpable tumors and 53.3 per cent. had food remnants. In other words, 33 per cent. had no palpable tumors and 46.7 per cent. had no food remnants to indicate obstruction. It is precisely in those cases which show neither tumor nor food remnants that the Roentgen-rays have their greatest field of usefulness and superiority. It is no longer necessary to wait until the tumor is palpable or until evidences of marked obstruction exist.

There is no intent to say that the clinical data should be discarded. On the contrary, the roentgenologist should in every instance be acquainted with the clinical facts. If suggestive of cancer, they will stimulate him to a more exhaustive search. If negative, they will exercise a wholesome restraint upon his interpretation of the reflex phenomena so often produced by conditions outside the stomach. More important still, the final diagnosis should be compatible with all the findings, if possible, and occasionally only their correlation will make the diagnosis. A combination of all methods forms a net through which few cancers will escape.

It must be conceded that the carcinomatous character of tissue can be positively determined only by the microscope, and the Roentgen rays can merely show the presence of a gastric tumor, which may or may not be malignant. However, benign gastric neoplasms are uncommon; according to Graham,[2] 95 per cent. of tumors of the stomach are cancer. Further, in the occasional instance of a non-malignant new growth, if the salient features of the clinical history are considered, the diagnostician will be at least suspicious of the fact.

The roentgenologic manifestations of gastric cancer include departures from the normal contour, pyloric action, peristalsis, motility, flexibility, mobility, position, and size of the stomach. Enumerated in the order of their relative importance, these signs are:

1. Filling defects.
2. Alterations of pyloric function: (*a*) gaping of the pylorus, (*b*) obstruction of the pylorus.
3. Perversion of peristalsis: (*a*) absence of peristalsis from involved areas, (*b*) weak peristalsis, (*c*) antiperistalsis, (*d*) exaggerated peristalsis, (*e*) irregular peristalsis.
4. Altered motility: (*a*) rapid and early emptying (non-obstructive cases), (*b*) delayed emptying (obstructive cases).
5. Lessened flexibility.
6. Lessened mobility.
7. Diminished size (capacity).
8. Displacement.

Filling Defects. The filling defect is the basic radiologic sign of cancer and practically indispensable to a positive diagnosis. It

[2] Differential Diagnosis of Diseases Causing Gastric Disturbance, Northwestern Lancet, 1910.

is occasioned by the projection of the tumor into the barium-filled lumen of the stomach, thus producing irregularity of contour. At the stage at which most patients first come for examination, the tumor usually has attained considerable size, and the filling defect is sufficiently extensive to be readily seen.

In aspect, filling defects vary somewhat according to the character and seat of the neoplasm. The fungoid cancer often shows multiple gross irregularities, gradually shading off into the barium shadow, giving a more or less stereoscopic effect to the elevations and depressions.

The infiltrating scirrhous cancer may greatly, though somewhat irregularly, narrow the lumen of the affected portion, which is most commonly the pylorie end.

A small cancer at the pylorus may produce a broadening of the duodenopylorie hiatus or a conical vestibule. A more extensive cancer may seemingly cut off the entire prepylorie segment.

Cancer of the pars media may result in an hour-glass deformity. High up in the cardia the tumor may infringe upon the contour of the gas-bubble and contrast with the transluceney of the latter.

A tumor on the anterior or posterior wall alters the contour in the sagittal view; in the anteroposterior view it may show centrally as a less dense area within the barium shadow.

The actuality and permanence of filling defects cannot be determined with finality by a few roentgenograms alone. Essential here is the screen examination, during which the gastric shadow can be studied at various angles by turning the patient and the effect of active and passive movements observed.

A true filling defect is permanent, showing no change in location or appearance after palpating manipulation, after administration of antispasmodics, or upon reëxamination.

Absence of peristalsis from the suspected area is highly confirmatory.

The correspondence of a filling defect to a palpable mass is strongly indicative of its genuineness.

Irregularity of outline and lack of symmetry are rather constant in true filling defects.

Filling defects in the pars media are less likely to be overlooked than those in the pars cardiaca or the pars pylorica. A filling defect high up in the cardia may not contrast strongly with the translucent gas-bubble. It may be brought into better relief by pressing the barium upward, or by screening and plating in the recumbent position. Small, filling defects in the pars pylorica require careful study for detection, owing to the difficulty of obtaining a clear outline of this region, because of its proximity to the spine, and the tendency of the barium to settle away from the pylorus of a fish-hook stomach. A small defect, which may be well seen in the partly filled stomach, may be concealed in the distended stomach. Hence,

observation should be made during the process of ingestion as well as after repletion. The screen diaphragm should be actively employed and the aperture narrowed to increase the distinctness of small suspected areas, thus facilitating close scrutiny. Filling defects situated in the pars media often produce hour-glass deformity. More commonly such an hour-glass is of the X-type in contradistinction to the usual B-type of gastric ulcer or spasm, but this distinction is not invariable. As a rule, the hour-glass of cancer lacks the sharply defined contour of the hour-glass due to ulcer or spasm, and shows an indefinite shading off.

Filling Defects from Causes Other than Cancer. Filling defects, either apparent or real, may be produced by numerous conditions other than cancer. Apparent filling defects may result from the use of faulty media (stiff media, poorly mixed or without sufficient barium; secretion in the stomach; food remnants; hair ball (trichobezoar); gas or fecal matter in the colon; barium in the bowel adjacent to the stomach; lordosis and scoliosis; pressure of the stomach against the spine; pressure of a deformed costal arch; strong retraction of the upper abdominal wall; spasm; adhesion from perigastric inflammations; extrinsic tumors, including those of the liver, spleen, pancreas, kidney, large and small bowel, omentum, mesentery and belly wall; displacement and distortion of the stomach by ascites, ovarian cysts, pregnancy, etc. Actual filling defects not distinguishable of themselves from those of cancer, may be caused by various benign tumor-producing lesions of the stomach.

Faulty media in which the barium is irregularly distributed may give varying degrees of opacity in the gastric shadow and thus imitate filling defects. The mixture may be too stiff, poorly mixed, or an insufficient quantity of barium may be used. With very thin mixtures the barium often settles to the lower pole, leaving irregular shadings along the lesser curvature. A little palpatory shifting of the gastric contents readily shows the character of these pseudo-defects, and erroneous interpretation is not likely to occur unless an attempt is made to base a diagnosis upon plates alone.

An excessive amount of secretion in the stomach, while it usually rises above the opaque meal, may mingle with it irregularly or thin its consistence. Sometimes secretion is imprisoned in the pyloric end of a fish-hook stomach, showing as a clear area above the opaque meal. The straight horizontal line of demarcation between the secretion and the barium is indicative of the artificial nature of the defect. By palpatory pressure the secretion can be displaced by the meal, or is passed into the duodenum.

Food masses in the stomach, by excluding the barium from the area in which they lie, may simulate filling defects. Here palpatory shifting of the gastric contents will cause the seeming defect to change its situation or disappear. However, as a matter of routine,

patients should be examined only in the fasting condition. Employment of the tube to withdraw food remnants in cases of pyloric stenosis, unless otherwise contra-indicated, may be resorted to if desirable.

Occasionally a hair ball (trichobezoar) is found in the stomachs of neurotic persons who are addicted to biting the hair. The accumulation may be a rounded ball of various size, or may form a complete cast of the gastric cavity. After giving the barium meal, the stomach shows an area of diminished density somewhat like the filling defect produced by cancer on the anterior or posterior wall, the peripheral contour showing fairly well. If the ball is small it can be displaced by manipulation or even forced up into the gas-bubble.

Gas in the colon is a common source of annoyance. Even after preparation of the patient by purging there is usually more or less gas in the splenic flexure. Frequently the distention is sufficient to infringe upon the greater curvature and produce considerable irregularity. Such irregularities ought not to be very deceptive, as they change with manipulation, and the distention of the transparent loop of intestine is rather obvious. If the gas-bubble is intruded upon, the colonic haustra are usually evident. Occasionally the transverse colon may be displaced upward and lie directly across the stomach. Its course may be traced by its transparency and haustration. Fecal matter in the bowel might possibly cause indentations in the adjacent gastric contour, although we have never seen this condition.

Masses of barium from the six-hour meal, in the bowel adjacent to the stomach, sometimes produce apparent irregularities of the gastric contour on the plate. By the screen examination with changing positions and palpation their character is easily seen.

Deformities of the dorsal and lumbar spine, including lordosis and scoliosis, may deform the contiguous gastric contour. Such conditions are rather manifest and rare.

Pressure of the stomach against the spine, either normal or with well-marked physiological lordosis, often disfigures the transspinal portion of the stomach. This disfigurement is often seen on the plates made with the patient's abdomen pressed tightly against the cassette. Not rarely it is also observed during fluoroscopy, especially when the patient maintains a high degree of abdominal rigidity and tension.

Strong retraction of the belly wall sometimes occasions a wide, regularly curved depression in the greater curvature of the stomach just below the left costal arch. Its smooth, sharp outline and its situation should differentiate it from an actual filling defect.

Spasm of the gastric musculature may produce very deceptive imitations of the filling defects caused by cancer. Migrating or intermittent spastic contractions, which are frequently seen, are

evidently spasmodic because of their changing situation or interruption; but spasm is not always migratory or intermittent. Often a non-moving, spastic incisura will indent the stomach so as to form an hour-glass, exactly simulating an organic hour-glass stomach. In other cases the entire pyloric portion of the stomach may be constricted to a stiff, narrow tube, rolling under the palpating fingers as a cylindrical mass. Again, the entire stomach may be spastically contracted, small, and of finely irregular contour, without definite peristalsis. In all the above conditions the outline of the stomach, though not regular, is sharply defined, and this circumstance should put the observer on guard. However, there is still another variety of spasm which is dangerously misleading; in this form the barium shadow in the spastic area, which may be large or small, fades off toward the gastric periphery, exactly as though intruded upon by a tumor mass. The spasm may sometimes be effaced by massage during the screen examination, but reappears, as a rule. If accessible to palpation the absence of a tumor from the suspected region should suggest cautious interpretation. The pyloric portion of the stomach is a common seat of this spastic deformity.

The points of difference between the true filling defects and those produced by spasm can be summed up as follows:

The true defect is permanent, often corresponds to a palpable mass if accessible, and is not often sharply delineated.

The spastic filling defect is often migratory or transient, is frequently sharp in outline, and the contracted muscle is rarely palpable. Spasm may disappear upon distracting the attention of the nervous patient or by causing him to relax his abdomen, or by vigorous palpatory manipulation; or it may disappear or change its situation at a second examination. In a great many cases reëxamination after the administration of an antispasmodic is necessary. Belladonna, atropin, and papaverin are the drugs most generally employed. Commonly we give the tincture of belladonna in 15 ℥ doses, t. i. d., for two or three days or until the patient shows its effects. This procedure should never be omitted in any case in which the possible existence of spasm cannot absolutely be eliminated. In rare instances spasm may persist in spite of this measure, but such cases are quite uncommon.

Adhesions from perigastric inflammations may produce distortions and irregularities resembling the filling defects of cancer. The inflammatory process originates most commonly from perforating gastric ulcer or from pericholecystitis. A perforating gastric ulcer in the pars media producing perigastric adhesion is apt to reveal its identity by a pocket, a niche, or an incisura. Perforating ulcer in the pars pylorica may be less characteristic, but these cases have been quite rare in our experience.

Pericholecystitis, with extensive adhesions about the pars pylorica,

accompanied, as it often is, by a gaping pylorus and sometimes producing a palpable mass, may be difficult to differentiate from cancer. Here only careful judgment of all the facts will prevent diagnostic error.

Tumors extrinsic to the stomach may deform its contour. Such tumors may originate in the liver, spleen, pancreas, kidney, large or small bowel, omentum, mesentery, or belly wall. As a rule, the filling defect occasioned by their thrust into the gastric lumen is quite smoothly regular, the inequalities of the tumor being covered by the wall of the stomach. Unless adherent to the stomach, which is not usual, changes of position of the stomach with respiration or by palpation will alter the location of the filling defect. In these cases, also, the peristalsis is usually normal, and this fact speaks against a tumor of the stomach itself.

The stomach may be eccentrically distorted and displaced by ascites, ovarian cysts, and other large abdominal tumors, pregnancy, or even by a tensely retracted abdominal wall. Such conditions should be rather patent.

Intrinsic tumor masses produced by syphilis and benign neoplasms, as well as varicosities of the gastric veins, may cause filling defects practically identical with cancer. These conditions are so unusual that the roentgenologist should not be unduly alert for them.

Alteration of Pyloric Function. In cancer the pyloric function may be perverted in either one of two quite opposite ways: namely, either by gaping or obstruction. The barium water often flows through a normal pylorus, with little or no interruption; but as soon as the thicker pap is given the flow usually becomes scanty or intermittent. The gaping pylorus of cancer is characterized by a free and continuous exit of both mixtures into the intestine. Very commonly the stream is voluminous and the upper small bowel is speedily filled with the opaque mixture. The stomach may be almost or even completely emptied during the brief period of examination.

Gaping of the pylorus results from an interference with its sphincteric contraction, either by infiltration and stiffening of the muscular ring or by an absence of the pylorus-closing reflex. Thus it is seen quite typically in scirrhous cancer involving the pars pylorica, but it is also found in association with cancers of the cardia or media, either scirrhous or medullary. A free and continuous flow somewhat similar to that seen with the gaping pylorus of cancer may be found in other conditions, such as duodenal ulcer, gall-bladder disease (with or without adhesions), achylia, certain diarrheas, and sometimes even in chronic appendicitis. It should be said, however, that in these conditions the flow is less voluminous, as a rule, than that noted typically in cancer.

Pyloric obstruction, as evidenced by a six-hour residue in the

stomach occurs in about 60 per cent. of gastric cancers—oftener than with any other lesion. The amount of residue varies with the degree of obstruction. In the majority of instances cancers producing pyloric obstruction are of the medullary type. It is noteworthy that the lumen of the pylorie canal may be considerably diminished by the intrusion of a cancer without resulting in a six-hour residue, for the reason that the lessened caliber is compensated by the lack of sphincteric control. Since numerous causes other than cancer may operate to produce a six-hour gastric retention, the presence of a residue should not be given undue weight in making the final diagnosis, but its occurrence should stimulate a careful search for filling defects and other evidences of cancer.

Peristalsis. The perversions of peristalsis resulting from gastric cancer are varied. Absence of peristalsis from a cancerous area of the gastric wall due to local loss of muscular contractility is a highly valuable sign. In some such instances a wave may progress to the affected site, skip it, and take up its course again beyond, and this observation is one test for the genuineness of cancerous filling defects. Weak peristalsis, the waves being both shallow and infrequent, is fairly common in cancer. Frequently the stomach seems to be perfectly inert. Antiperistalsis is occasionally observed in cancer with pyloric obstruction. The antiperistaltic waves are best seen on the greater curvature in the pars pylorica and media. The waves are usually wide and shallow, though sometimes deep. Beginning at the pylorus, they sweep slowly backward and disappear in the upper media. They may coexist with peristaltic waves traveling in the normal direction. Exaggerated peristalsis, as a sequence of cancer with pyloric obstruction, is more rare than might reasonably be supposed. When seen, the exaggeration is usually more marked on the greater curvature. Peristalsis in cancer may show other eccentricities. It may be irregular as to the depth and succession of the waves; a fairly deep wave may be closely followed by a shallow one, while the next may be normal as to depth and rhythm. None of the foregoing perversions of peristalsis is peculiar to cancer, and they are merely indicative of a pathological process.

Altered Motility. Emptying of the cancerous stomach may be either retarded or accelerated, according to the presence or absence of pyloric obstruction. In the non-obstructive cases hypermotility is the rule, and is a natural sequence of the achylia and gaping pylorus. The acceleration of gastric clearness may be extreme and the stomach evacuate itself with extraordinary rapidity. The acceleration is often exhibited not only in a rapid and early clearance of the stomach, but also in an advanced position of the six-hour meal, the head of the barium column appearing in the transverse colon, the splenic flexure, the descending colon, or even the ampulla. In the obstructive cases, delayed clearance is shown by

the six-hour residue. That portion of the meal which has passed through into the intestine may or may not show retarded progress. It is to be remembered that gastric motility may be affected by many things other than cancer. Hypermotility of moderate degree is a common sequence of non-obstructive duodenal ulcer, achylia, and diarrheic conditions. Hypomotility, with or without a six-hour retention, may result from any sort of organic obstruction at the pylorus or near beyond, or from reflex pylorospasm.

Lessened Mobility. By involving adjacent structures a cancer not infrequently produces more or less fixation of the stomach. The attachment may be to the abdominal wall, or to the liver, pancreas, or other viscera. The presence of fixation may sometimes, but not always, be determined by palpatory maneuvers, depending upon the position of the stomach, the situation of the attachment, and the degree of laxity of the abdominal wall, and, also, by observation during forced respiration. The small, high-lying, contracted stomach, inaccessible to manipulation, though it appears to be fixed, is not necessarily so. On the other hand, a stomach which has a free and flexible lower pole may seem to be freely mobile, when there are definite adhesions on the lesser curvature. Inasmuch as fixation is simply an indication of extragastric involvement, it is merely a contributory sign of cancer. It may be taken into account in estimating the possibility of resection.

Lessened Flexibility. Diminished flexibility of the cancerous gastric wall is a practicable and valuable sign, especially of scirrhous cancer. Upon narrow palpation with a single finger or with the ulnar edge of the hand the accessible normal gastric wall will show corresponding indentation, whereas if stiffened by infiltration it will either be disproportionately indented or be moved aside *en masse*. The loss of pliability may also be somewhat evident by the lack of contour change during deep respiration or during variations of abdominal tension. Further, it may show as a lack of expansibility in the affected portion during the process of filling the stomach, the lumen of the involved area being almost constant in size at all degrees of repletion, while the unaffected portion expands to accommodate the increased volume.

Diminished Size and Capacity. A common feature of the cancerous stomach is marked diminution of the capacity and apparent size. The reduction may be the result either of the projection of large fungoid masses into its lumen or the shrinking effect of scirrhous infiltration. In extreme instances, the effort to accommodate the ingesta causes a backing up of the meal in the esophagus, which latter may show dilatation. Besides cancer, other causes which may lessen the capacity of the stomach are perforating ulcer, with extensive perigastritis, spasm, and benign lesions. The upper loculus of an hour-glass stomach may be mistaken for a contracted stomach if the presence of the lower loculus be over-

looked. It must also be remembered, on the other hand, that an obstructive cancer at the pylorie end may result in considerable dilatation of the stomach. A similar dilatation may be consequent upon other obstructive causes. It follows then that neither large nor small size of the stomach is especially significant of cancer, but marked variation in size of the stomach is at least suggestive of the presence of a lesion.

Displacement. The predilection of cancer for the pylorie end of the stomach, often with more or less complete obliteration of the distal portion of its lumen, results frequently in an apparent displacement of the stomach to the left, since its proximal portion only is visualized. Aside from this, however, there may be actual displacement upward and to the left in cases of scirrhous cancer, and the diminished organ may lie entirely up under the shelter of the left costal arch. Somewhat similar displacements may occur as a result of perforating ulcer, ascites, tumors outside the stomach, and retraction of the abdominal wall.

PATHOLOGY. With the microscopic pathology of gastric cancer the roentgenologist has little concern, but the roentgenologic appearances of cancer sometimes depend quite considerably upon its character as affecting its form, location, and extent. Hence, a few statements concerning certain anatomical varieties of cancers and their gross aspects may assist in clarifying the description of this lesion, as seen by the Roentgen rays.

Cancers of the stomach invariably originate in the mucous layer. While they are all basically epithelial neoplasms, they present numerous structural differences. Disregarding those variations which are here unimportant, there are three forms which are of chief interest from a radiologic standpoint:

1. A proliferative form, almost wholly epithelioid in composition, with circumscribed tumor production. This is the *fungous* type with which may be included for present convenience the medullary (encephaloid), cauliflower and adenocarcinomas. It is characterized by a relatively small amount of interstitial tissue, and hence is soft.

2. An infiltrative form. This is the *scirrhous* type. Speaking in a general way, it infiltrates the gastric wall with less irregularity and less projection into the cavity of the stomach than is seen in the fungous type. It is characterized by a relatively large amount of interstitial tissue, is hard, and is more frequently associated with ulceration than the other types. The infiltration may be either (*a*) localized or (*b*) general.

(*a*) When localized, the pylorie end of the stomach or the lesser curvature is the part most commonly affected, the greater curvature being rarely involved at the beginning.

(*b*) The general diffuse infiltration involves a large part or the whole of the stomach, which is thick-walled and contracted. This

is regarded by many as identical with the so-called "leather-bottle" stomach, or "diffuse fibrosis," and is rather rarely seen.

3. A degenerative form, the so-called "colloid," or, more correctly, mucoid cancer. In this form the cells lose their structure and become merged into a homogeneous mucoid mass. Mucoid degeneration may occur in either the fungous or scirrhous type.

It will be understood that the three forms mentioned do not always or necessarily exist independently of each other, that the classification and descriptions are practical rather than accurate, and that differentiation of these forms is not always easy. Sometimes these pathological differences in gastric cancers are sufficiently manifest in the roentgenologic picture to warrant an opinion as to their probable nature; however, such an opinion should be advanced with caution, and then only in those rather few cases which are typical, for, in the majority of cases, the roentgenologist would better be content with a diagnosis of cancer without attempting to specify the particular variety.

Roentgen Characteristics of Fungous Cancer. In a broad way the typical fungous (medullary, encephaloid) cancer shows the following:

1. A non-shrinking effect upon the stomach as a whole. While the capacity of the stomach may be somewhat lessened by the encroachment of the mass upon its lumen, the gastric dimensions are not otherwise diminished. Often the hook form is preserved and this retention of the hook form has been suggested by Haudek as an indication of resectability.

2. Occasional involvement of the greater curvature, especially of the body of the stomach.

3. Sharp delimitation of the involved from the non-involved portion of the gastric wall.

4. Often large, multiple, irregular filling defects projecting into the gastric lumen and shading gradually into the central barium shadow, somewhat resembling impressions upon paraffin.

5. If at the pyloric end this type is likely to produce obstruction.

Roentgen Characteristics of Scirrhous Cancer. Typical advanced scirrhous cancer may be recognized by:

1. Its marked shrinking effect upon the stomach. The capacity of the stomach is not merely lessened by a filling defect, but is greatly diminished by the loss of expansibility due to widespread infiltration as well as actual contraction.

2. Frequent involvement of the pyloric end and lesser curvature. Quite commonly a scirrhous completely encircles the pyloric end and the deformity thus produced gives the stomach some resemblance to a curved funnel or an Indian pipe. The barium projects into the canalized pyloric mass as a smooth or slightly irregular spicule.

3. Gradual merging of involved into non-involved portion of the gastric wall. The limits of the lesion are difficult or impossible to determine radiologically. The lesion is usually more extensive than the picture indicates.

4. The filling defects of scirrhous cancer are commonly less grossly irregular than those of the fungous type.

5. This type of cancer, even though involving the pars pylorica, is likely to show a gaping pylorus.

Mucoid Cancer. A markedly diminished, fairly regular central lumen surrounded by a thick-walled tumor mass is sometimes seen in extensive mucoid degeneration, but mucoid change can rarely even be surmised by the radiologic appearances. It gives practically the same screen and plate picture as the infiltrative form (scirrhous).

Carcinomatous Ulcer. While by far the greater number of gastric cancers manifest themselves frankly as tumors at the time the patients present themselves for examination, ulcers are found occasionally which show microscopic evidence of malignancy. In their gross characteristics and roentgenologic appearances these ulcers are not different from benign ulcers. In most instances the crater of the ulcer is visualized as a niche projecting from the gastric lumen. This may or may not be associated with hour-glass stomach, an incisura, or six-hour retention. The only suspicious feature sometimes shown by the Roentgen rays is the extraordinary large size of the ulcer crater. In a few of our own cases in which the niche was 3 or 4 cm. broad the ulcer was found on microscopic examination to be malignant.

OPERABILITY. In deciding the question of operation in a given case of cancer the Roentgen rays furnish information of high, often decisive, importance. Primarily, operability depends considerably upon the skill of the operating surgeon; but aside from this certain radiologic findings speak for or against operation, whether radical or palliative. The location, extent, and character of the cancer are all matters of fundamental weight. Growths involving the cardia or upper media are not accessible to resection, while those at the pyloric end or lower media are often resectable. Obviously, resectability depends also upon the extent of involvement, and this can be more nearly determined by the Roentgen rays than by any other method. The actual extent of a medullary cancer corresponds closely to that indicated radiologically. The limits of a scirrhous cancer are much less sharply defined in the Roentgen picture and a liberal allowance must be made in estimating the probable degree of involvement.

Free mobility of a cancerous stomach is an item favoring resectability, while marked fixation resulting from extension to adjacent structures makes successful intervention less probable. However, a cancer which does not extensively involve the stomach or appear

to have lessened its mobility materially may at operation be found to have invaded and be adherent to a near-lying organ, such as the pancreas, and resection of the growth is impossible.

Retention of the hook form of the stomach, which has been advanced as an indication of resectability, is often found in cases that are manifestly inoperable.

Regarding metastasis, a factor which has always to be considered, the Roentgen examination can rarely give any knowledge. Extensive metastasis in the lungs may be observed casually during the screen examination, or an abnormally large shadow of the liver may be a suspicious circumstance and these should always be looked for; but widespread glandular metastasis may exist without detection.

Years ago, Czerny[3] pronounced cases of cancer with definite palpable tumors of the stomach to be inoperable. This is rather extravagant, since many such cancers are resectable, and when there is no glandular involvement or invasion of adjacent tissue the chance for cure is good. Further, not every palpable tumor is a cancer; the mass may be a perforating ulcer with adhesions, pancreatic cyst, floating spleen or various lesions originating in the gall-bladder.

On the clinical side, the evidences of inoperability have been summed up by Mayo[4] as follows:

"1. The cachectic patient with marked evidence of progressive gastric trouble which has lasted over a period of a number of months, with a fixed tumor lying to the left. Such a case would be clearly hopeless.

"2. It frequently happens that with cancer of any of the abdominal viscera there will be an escape of cancer cells into the peritoneal cavity. These will drop, by gravity, to the bottom of the pelvis and become attached often to the sigmoid. The "feel" of these various small metastases upon rectal examination is very characteristic. In women, not infrequently transplantation to the ovary occurs, setting up a secondary malignant cyst. The majority of cases of malignant adenocarcinomas of both ovaries have such origin, and women are sometimes unnecessarily submitted to operation for their removal.

"3. The supraclavicular fossa, especially the left side, should be examined for carcinomatous glands.

"4. Cancer cells free in the abdominal cavity can be carried by the lymphatics to the umbilicus, forming a distinct mass like a button. In doubtful cases I remove, under local anesthesia, a little portion of this "button umbilicus" for microscopic examination.

[3] Quoted by M. B. Tinker, What Stomach Symptoms Justify Surgical Intervention? Jour. Amer. Med. Assn., 1915, lxiv, 1789.

[4] Cancer of the Stomach: its Surgical Cure, Surg., Gynec. and Obst., 1912, xiv, 115-119.

"5. Metastatic deposits, giving rise to nodular tumors in the liver or peritoneal cavity.

"6. Ascitic accumulations in the abdominal cavity, taken in connection with the history of the patient, have some value. It is necessary to eliminate other causes of ascites—for example, the heart, liver, kidneys, tuberculous peritonitis, etc."

Roentgenologic determination of the absence or presence of obstruction, its site and degree, aids materially in judging the advisability of palliative surgery and in selecting the operation, whether gastro-enterostomy, gastrostomy, or jejunostomy. In expressing any opinion as to operability, unless the cardia or upper media is definitely implicated, or unless the growth is extraordinarily extensive, the roentgenologist should be chary of saying that a case is inoperable, as he may thus deprive the patient of relief or cure at the hands of the surgeon. In the majority of instances exploration alone is the final word and the patient should be given the benefit of the doubt. Besides, there is always at least a remote chance that the most confident diagnosis may be wrong.

EARLY CANCER. The term "latent cancer" is sometimes applied to cancers which give rise to few or no symptoms or signs and which cannot be diagnosed clinically. Since "latent" also carries the sense of quiescence or dormancy, a condition which has not been proved as regards gastric cancer, the adjective "early" is perhaps preferable.

A very practical question is, "How early can the existence of a gastric cancer be determined by Roentgen rays?" Since even in advanced cases Roentgen rays show only the presence of an organic lesion, the nature of which can only be predicated upon all the circumstances of the case, the actual question is, "How early does gastric cancer reveal roentgenologic signs which may reasonably be attributed to cancer and consequently which justify surgical intervention?" Admitting that the only cure for cancer is early operation, early diagnosis is a matter of prime importance. Admitting also that there are no definite clinical findings in early cancer, the statement is warranted that next to the exploring finger of a trained surgeon, Roentgen rays will reveal more cancers in the early stages than will any other diagnostic means. Hence every patient of cancer age with indefinite gastric symptoms should be subjected to a Roentgen examination. But how early can cancer of the stomach be detected? That depends upon:

1. The character of the cancer, whether a frank tumor, an insidious infiltration or a cancerous ulcer.

2. Its situation.

3. The examiner's familiarity with the work.

4. The amount of roentgenologic evidence, together with the extent of clinical corroboration.

Cancer which begins candidly as a tumor projecting into the

gastric lumen is susceptible of quite early recognition by reason of the filling defect which it produces. The test of this sign is its permanence, not its size, and we have been fortunate enough to find one which was not larger than a cherry. The discovery of even smaller ones is no doubt possible. A stealthy infiltrative cancer of the fibrous or scirrhous type may invade the gastric wall without producing a recognizable filling defect. In this event peristalsis should be notably absent from the involved area, and a local loss of flexibility may be evident upon palpation. When these signs alone exist they should be interpreted with caution; but in conjunction with a gaping pylorus, achylia and clinical indices, they may warrant a surgical exploration.

Carcinomatous ulcers for the most part show the same roentgenologic signs as simple ulcers. However, as stated, ulcers with excessively large craters are open to the suspicion of being cancerous.

The situation of a small cancer makes a decided difference in the chance of its demonstration. On either curvature of the pars media or pars pylorica, filling defects, even though small, can usually be visualized either on the screen or plate, or both; but such defects on the anterior or posterior wall might evade observation even in the oblique view. Trifling defects in the region of the gas-bubble are also apt to be overlooked. The percentage of cancers in the pars cardiaca is, however, small.

The experience of the examiner and his ability to see and interpret slight departures from the normal have some importance in the diagnosis of early cancers. The novice would better limit his diagnoses to those cases in which he can demonstrate a permanent filling defect, and which are at least suspicious clinically. Anyway, these features will be found in the vast majority of patients with gastric cancer who seek medical aid.

Patients with early cancer near the pyloric ring producing obstruction are more likely to come into the hands of the roentgenologist than patients with early cancer beginning elsewhere in the stomach. A six-hour retention, evidencing obstruction, may be the only abnormality of which the observer feels sure. In other cases there may be a slight but permanent irregularity of the prepyloric contour, with or without obstruction, in which one can only say with certainty that a lesion of some sort is present. While it is highly important that gastric cancers be discovered at the earliest possible moment, it is also highly important that the diagnosis shall be well founded, and where the Roentgen findings plus the clinical features of the case do not quite justify operative intervention, the patient should be reëxamined at short intervals until a decision is reached. The administration of belladonna to eliminate the possibility of spasm in doubtful cases is particularly advisable.

Interpreting the Signs of Cancer. The Roentgen indications of gastric cancer vary markedly in degree and in their combinations

with each other, as will be seen in the case reports herewith appended. The cases with which the roentgenologist has to deal thus range all the way from those which are plainly cancer to those which are highly doubtful. Often he can only be positive that a pathological condition exists. In every case he should be acquainted with the salient clinical facts, which should at least grossly correspond to his own findings. If they do not agree, he ought to confirm his observations by repeated examinations.

CASE I (97408).—Man, aged forty-three years. He had attacks of indigestion five years prior to examination, with slight pyrosis and vomiting, which ceased after medical treatment. For five weeks he has been having spells of sharp epigastric pain, relieved by

FIG. 1

rest and aggravated by exercise. No loss of weight. Hemoglobin 89. Total acids, 86; free HCl, 62; combined, 14; no food remnants. *Roentgen findings:* Small prepyloric filling defect. Retention of half the six-hour meal. Active peristalsis (Fig. 1). *Diagnosis:* Lesion at the pylorus. *Operation*: Resection four inches of stomach (Billroth, No. 1); early cancer on pyloric ulcer. *Pathologist's report:* Ulcer, early cancer.

It will be noted in the patient's history that the symptoms complained of were indefinite and not especially indicative of cancer. Such an early lesion could hardly have been discovered except by Roentgen rays or by exploration. This is a typical early case, in which good results can be expected from operation.

CASE II (90713).—Man, aged sixty-seven years. Four months ago the symptoms began with belching and regurgitation of sour, foul-smelling water a half to one hour after meals. There was sticking, heavy, left epigastric pain soon after eating. Loss of weight 15 to 20 pounds. Total acids, 56; free HCl, 42; combined, 14; food remnants; blood. Epigastric resistance and tenderness, but no mass palpable. *Roentgen finding:* Small filling defect, pyloric end. No palpable mass corresponding to defect. Retention of three-fourths of the six-hour meal. Stomach large, showing

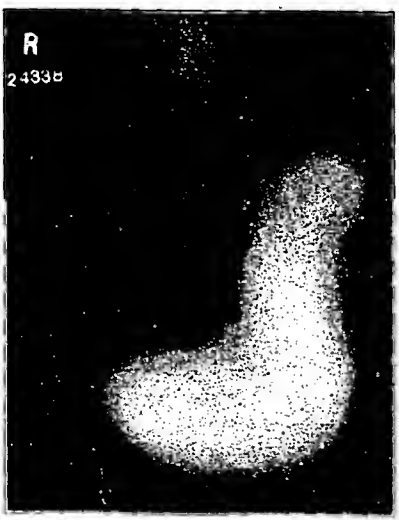

FIG. 2

irregular vigorous peristalsis (Figs. 2 and 2*A*). Fig. 2*A* shows the retention after six hours. *Diagnosis:* Carcinoma, pyloric end. *Operation:* Cancer in the pyloric end of stomach, ulcer type, with marked obstruction. Adherent to pancreas. Extensive glandular involvement. Resection of one-half of the stomach (Mikulicz-Hartmann-Billroth, No. 2). *Pathologist's report:* Cancer. Photographs of gross specimen shown in Fig. 2*B*.

While this is a fairly early case roentgenologically, as shown by the limited involvement of the stomach, the surgical findings prove that even small cancers of the stomach are not always favorable

for resection, because of extension to adjacent tissues and glandular involvement.

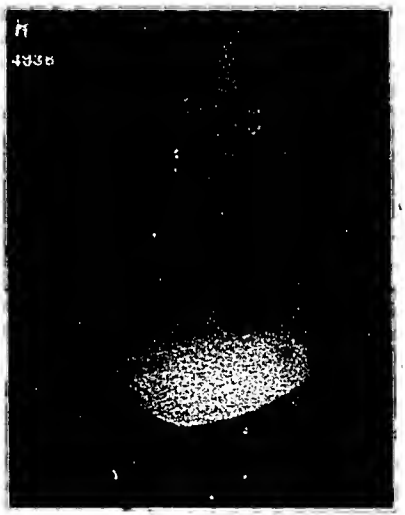

FIG. 2A

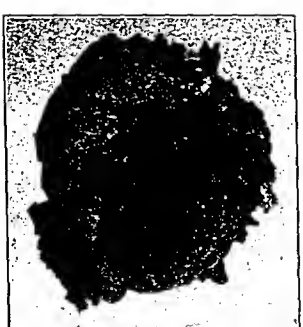

FIG. 2B

CASE III (122965).—Man, aged thirty-six years. This patient had had indigestion off and on for ten years. Onset of present trouble two months ago. Distress, gas and nausea three or four hours p. e., with regurgitation of acid and mucus. Loss of weight 8 pounds. Movable ridge at right epigastrium. Total acids, 40; free HCl, 0; combined, 40; food remnants, 2; blood, yeasts, sarcines. *Roentgen findings:* Large stomach, containing three-fourths of the six-hour meal. Filling defect in the pars pylorica corresponding to a palpable mass (Fig. 3). *Diagnosis:* Cancer, operable so far as the extent of the involvement of the stomach is concerned. *Operation:* Resection of two-thirds of the stomach (Mikulicz-Hartmann-Polya). Cancer, pyloric end. *Pathologist's report:* Cancer with glandular involvement.

FIG. 3

This patient had slight gastric disturbance for ten years, as stated above, and had been seen repeatedly by competent gastro-enterologists, one of whom sent him to Europe for a vacation trip. Another sent him to Florida last winter. He had had Roentgen examination by one or two inexperienced men, who were also practising internal medicine. The case was not recognized as cancer until a tumor developed. A careful roentgen examination should have shown the condition earlier and at a time more favorable for operation.

CASE IV (123461).—Woman, aged fifty-one years. For five years before coming for examination this patient had had intermittent attacks of epigastric pain two hours p. e., lasting weeks or

months, with intermissions of two to six months. For five months she has been vomiting whenever she ate a little more than usual, and during the past two months she has had epigastric pain immediately p. e. and at other times. Loss of weight 28 pounds in five months. Small, movable, tender mass in epigastrium. Hemoglobin, 85. Total acids, 20, all combined. *Roentgen findings:* Extensive filling defect involving both curvatures, extending well up into cardia, corresponding to palpable mass. No six-hour retention. Gaping pylorus (Fig. 4). *Diagnosis*: Inoperable cancer. No operation.

If this patient had been examined by Roentgen rays only a few months earlier there is little doubt that a diagnosis could have been made when surgery could offer some hope of cure.

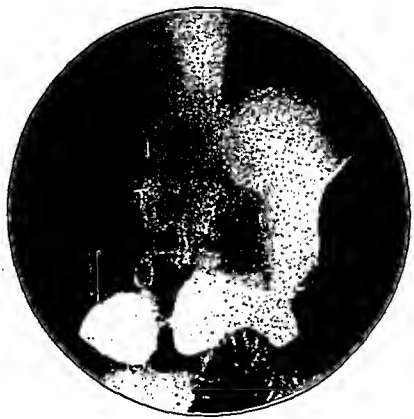

FIG. 4

CASE V (86914).—Man, aged sixty-one years. From the age of eighteen to forty-two he had attacks lasting three to five weeks once a year of epigastric pain an hour or two p. c., with sour regurgitation, etc. One month ago he had an attack of pain with vomiting followed by fermentation and distress. Five days later at his home exploratory operation showed tumor of the stomach which was not removed. Loss of weight, 26 pounds. Total acids 54; free HCl, 4; combined, 50. Large, movable ridge in epigastrium. *Roentgen findings:* Stomach small, with marked filling defect in the pars media and pars pylorica, corresponding to a palpable mass. Retention of half the six-hour meal. Stomach

somewhat fixed (Fig. 5). *Diagnosis:* Cancer. *Exploration:* Cancer of the pyloric end of the stomach; inoperable. *Pathologist's report:* Tissue removed, cancer.

This case shows how impossible it is to accomplish anything by surgery when such an advanced stage of the disease has been reached. The Roentgen rays were not at all necessary for a diagnosis in this case, but it showed the extent of involvement and its inoperability. Only by competent routine Roentgen examination of every person beyond cancer age with gastric symptoms, no matter how trivial, can the number of cases like the above be diminished.

FIG. 5

CASE VI (117798).—Woman, aged sixty-six years. In the past five years this patient has had many attacks of grinding pain in the right abdomen, coming suddenly and lasting from a few to twelve hours. For four months she has had daily distress and sour vomiting soon after meals. Loss of weight, 30 pounds. Hemoglobin, 85. Total acids, 24; free HCl, 16; combined, 8. *Roentgen findings:* Prepylorie narrowing. Retention of half the six-hour meal. Active peristalsis. Some irregularity and thinning of barium shadow along the greater curvature in the pars media, due to gas in the colon (Fig. 6). The case was regarded as suspicious for a prepylorie lesion. A reray after belladonna was requested, and this examination showed a stomach normal in contour and without retention. *Operation:* Cholecystectomy; appendectomy. Cholecystitis with multiple papillomas; chronic appendix. *Pathologist's*

report: Chronic cholecystitis with multiple papillomas. Chronic appendicitis.

This case illustrates the necessity of caution on the part of the radiographer. The prepyloric deformity and six-hour retention were due to gastrospasm as a reflex from the disease of the gall-bladder. This sort of gastrospasm is of quite common occurrence, and extreme care is necessary in differentiating it from an actual lesion of the stomach. The active peristalsis in this instance rather suggested spasm and negated cancer.

FIG. 6

CASE VII (102013).—Woman, aged sixty-nine years. Two years ago this patient began to have discomfort after meals. A year later she noticed a lump in the epigastrium which has increased steadily in size. During the past eight months occasionally she has been nauseated and vomited when hungry. Loss of weight, 45 pounds. Hemoglobin, 85. Total acids, 6, all combined. Oblong mass in epigastrium. *Roentgen findings:* Small stomach without visible peristalsis. No retention. Lessened flexibility. Slight fixation. Lumen narrowed without marked irregularity of contour (Fig. 7). *Diagnosis:* Cancer. *Exploration:* Inoperable tumor involving the entire stomach (leather-bottle stomach). Some glandular thickening but no metastasis.

FIG. 7

FIG. 8

CASE VIII (124629).—Man, aged forty-four years. Eight months ago he began to have epigastric pain, coming a half-hour to one hour after meals. The pain continued until about six weeks ago; since then he has felt well, but worries over loss in weight (15 pounds). A firm tumor could be palpated to the left of the umbilicus, indefinite in outline, moving with respiration, and visibly modified in shape, evidently by peristalsis. Total acids, 66; free HCl, 60; combined, 6. *Roentgen findings:* Extensive filling defects in the pars media and pars pylorica. No retention from the six-hour meal (Fig. 8). *Operation:* Resection of three-fourths of the stomach (Mikulicz-Hartmann-Polya). Cancer, two large masses projecting from the posterior wall. *Pathologist's report:* Cancer; no glandular involvement found.

FIG. 9

CASE IX (119622).—Woman, aged sixty years. For several years the patient has had, every five or six months, attacks of nausea and vomiting, without pain, lasting about a week. A similar attack began one month ago, at first without relation to food-taking, but during the past two weeks occurring a half to three hours after meals. No particular pain, but some epigastric soreness and burning. Loss of weight, 38 pounds in two years; mostly in the past two months. Hemoglobin, 76 per cent. Ridge in the left epigastrium palpable on deep inspiration. *Roentgen*

findings: Very large niche on lesser curvature. Retention of half the six-hour meal (Fig. 9). *Diagnosis:* Cancerous ulcer. (The opinion as to malignancy was based upon the unusually large size of the niche.) No operation.

CASE X (106071).—Woman, aged fifty-five years. For twenty years she has had attacks of severe epigastric, cramp-like pain, coming as often as every two weeks, lasting one or two hours, and without relation to food. For six months attacks have been more frequent; recently twice a day. Morphin for relief has been given. Vomiting of dark greenish fluid. Small, tender mass R. C. M. Loss of weight, 25 pounds. Hemoglobin, 85. Total acids, 40; free HCl, 28; combined, 12. *Roentgen findings:* Two examinations

FIG. 10

were made. The first showed marked irregularity of the pyloric end, without retention. The second examination, after giving belladonna showed practically the same condition (Fig. 10). *Diagnosis:* "Prepyloric irregularity; possible lesion; may be reflex." *Operation:* Cholecystectomy. Empyema of gall-bladder with stones. *Pathologist's report:* Cholecystitis. Cholelithiasis.

The cautious diagnosis in this instance was due to the fact that the patient had an excellent history of gall-bladder trouble. The patient at the second examination showed no physiological effects from the belladonna, and it was felt that spasm could still not be wholly excluded. Further, an organic lesion of the stomach producing such prepyloric irregularity would probably also have

resulted in a six-hour retention, antiperistalsis, palpable tumor, or other corroborative indication.

CASE XI (106124).—Man, aged seventy years. Intermittent diarrhea for six months with 3 to 6 bowel movements daily. Occasional day or two of relief. Much sour belching. On rigid diet five months, with 40 pounds loss of weight. Occasional pain in the lower abdomen or stomach. Hemoglobin, 75. Total acids, 14, all combined. Stool report: No parasites. Proctoscopic negative. *Roentgen findings:* Filling defect in the pars pylorica. No six-hour retention (Fig. 11). *Diagnosis:* Cancer. *Operation:* Cholecysteetomy. Large septic gall-bladder, with stones. Marked thickening of pyloric ring by spasm. *Pathologist's report:* Chronic catarrhal cholecystitis. Cholelithiasis.

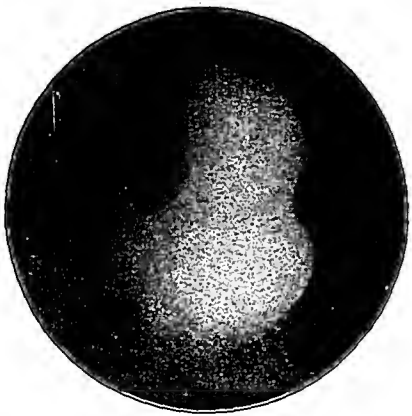

FIG. 11

Because of the patient's age and weakness the examination was effected with considerable difficulty. The findings, however, seemed quite definite and the possibility of spasm was not considered. The clinicians in charge of the case had considered it disease of the gall-bladder but upon the strength of the Roentgen-ray findings changed their diagnosis. The case is another illustration of the deceptiveness of gastrospasm.

CASE XII (120996).—Man, aged fifty years. Two or three months ago he began to have intermittent attacks of dull epigastric pain one hour before meals, lasting three or four days, with remissions of four or five days. Food relief. Some pyrosis, pallor,

Slight edema of feet and legs for three or four weeks. No distinct loss of weight. Mass, right hypochrondrium. Total acids, 10; free HCl, 0; combined, 10; blood and mucus. Hemoglobin, 40 *Roentgen findings:* Plates made with the patient standing show small defect on the greater curvature in the pars media, while those made prone show two large central defects; with some irregularity

FIG. 12

and thinning of both curvatures. No retention from the six-hour meal (Fig. 12). *Diagnosis:* Cancer. *Operative findings:* Anterior gastro-enterostomy; stomach opened; base of tumors clamped. Four cancerous papillomas growing from the mucosa of the stomach, varying in size from that of a filbert to that of a lemon. *Pathologist's report:* Multiple papillomas; areas of cancer.

THE SIGNIFICANCE OF ACRO-ATAXIA AND PROXIMO-ATAXIA.

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ACRO-ATAXIA is a term used to designate an impairment in the muscular sense of the intrinsic muscles of the hands and feet in contradistinction from ataxia of the proximal muscles of the upper and lower extremities.

The diagnostic significance of distinguishing between acro-ataxia and proximo-ataxia was first suggested in primary anemia when the differentiation brings out very striking symptoms. Patients with primary anemia complain of paresthesia in fingers and toes and impairment of fine manipulative movements long before there is any impairment in the grosser movements of the extremities. The lower extremities reveal this differentiation far more commonly than do the upper extremities. In the early period of primary anemia a patient will be unable to tell whether the great toe is being passively flexed or extended or twisted; but when the limb is elevated in various positions he will accurately indicate the position of the toe. The former test employs the muscular sense of the intrinsic muscles of the feet. The latter test employs the muscular sense of the iliofemoral muscles.

The anemic patient may lose all muscular sense in the intrinsic muscles of the feet and have no static ataxia, because the muscular sense of the iliofemoral muscles is unaffected. The anemic patient will have the muscular sense of the intrinsic muscles of the hand so impaired that buttoning a waist, washing dishes, sewing, and writing are laboriously and imperfectly accomplished; but when the finger-to-finger and finger-to-nose tests are tried, all indications of ataxia are wanting. In the latter instance we are testing the muscular sense of the thoracoscapular and scapulohumeral muscles to the exclusion of any function of the intrinsic muscles of the hands. Many patients with primary anemia with pronounced loss of muscular sense of intrinsic muscles of the feet and hands will voluntarily complain only of numbness and tingling, when direct questioning and testing will reveal a loss of the stereognostic sense which in a tabetic patient would render him incompetent for any occupation.

What first attracted my attention to the significance between acro-ataxia and proximo-ataxia was the surprising loss of the stereognostic sense in the hands and loss of all sense of position in the toes in anemic patients when there was not the slightest evidence of any loss of muscular sense in the proximal muscles of the upper or lower extremity, and for this reason the gait was not ataxic, there was no static ataxia, and with the exception of fine manipulations which employed only the hand muscles, there was no impairment of function in the upper extremities. In the later stages of anemia, proximo-ataxia and acro-ataxia are both present.

In spinal-cord disease we see just the reverse. Proximo-ataxia always precedes acro-ataxia. The tabetic patient will have a very pronounced loss of muscular sense in the iliofemoral muscles, with consequent symptoms, long before there is a loss of the sense of position in the toes. He will also lose the muscular sense in his thoracoscapular and scapulohumeral muscles before there is any

loss of muscular sense in the hands. Acro-ataxia is seen only in advanced spinal-cord disease.

Primary anemia is a hemolytic disease in which the nervous system suffers, probably from the same toxic substance which acts as hemolysine. This suggests the possibility of employing the differentiation between acro-ataxia and proximo-ataxia as a diagnostic measure to distinguish peripheral nerve lesions from lesions in the spinal cord.

For the past four years all cases of primary anemia with neurological signs and all forms of neuritis, *e. g.*, alcohol, lead, diabetes, and diphtheria, and all syphilitic disease of the spinal cord have been carefully studied with this idea in view. The results have shown that acro-ataxia without proximo-ataxia is seen only in the primary anemias and peripheral neuritis. Proximo-ataxia without acro-ataxia is seen only in cord disease. In advanced stages of peripheral nerve and cord diseases both proximo-ataxia and acro-ataxia may be present.

This differentiation has served to recognize cases of alcoholic neuritis which have simulated spinal-cord disease. Acro-ataxia may also suggest primary anemia when the patient's color will not suggest anemia. In our cases there were also three diabetic patients with neuritic pains who would have been treated as diabetic neuritis had they not had proximo-ataxia which betrayed the spinal cord as the real seat of the disease. They proved to be cases of syphilis of the central nervous system with glycosuria as a symptom.

One case of carcinoma of the prostate afforded an interesting example of the value of this sign. The patient had mild diabetes for twelve years. An enlarged prostate caused residual urine for two years. During the past year the patient has had much pain in the distribution of both sciatic nerves in the thighs and legs. Proximo-ataxia without acro-ataxia indicated that the neurological signs were not of diabetic origin. The subarachnoid fluid proved to be normal, therefore the cord lesion was due to metastases from a carcinomatous prostate. The prostate was removed surgically and proved to be carcinoma on histological examination. The patient has made a good recovery from his operation, so the character of the spinal-cord lesion still remains in doubt, although at the operation a chain of enlarged lymph glands were palpated along the iliac vessels, a fact which lends additional probability to the carcinomatous character of the spinal-cord disease.

That toxic neuritis may cause proximo-ataxia without acro-ataxia is possible, but we have not had cases which have clearly shown such a combination of symptoms. But during the past four years, during which the relations between acro-ataxia and proximo-ataxia and cord and peripheral nerve disease have been observed, we have failed to find a single case of spinal-cord disease in which acro-

ataxia existed unaccompanied by proximo-ataxia. When proximo-ataxia is unaccompanied by acro-ataxia, we have strong evidence that we are not dealing with a disease of the peripheral nerves.

During the past four years, at Lakeside Hospital we have had fifty-two cases of primary anemia, and in all of them in which neurological signs were presents there was either acro-ataxia alone or accompanied by proximo-ataxia. I have failed to find a single case of primary anemia in which proximo-ataxia existed unaccompanied with acro-ataxia. My experience with all cases seen outside the hospital has been the same.

Another striking experience occurred in primary anemia: Eighteen of the fifty-two cases at Lakeside Hospital were from fifty to sixty-seven years of age, and in sixteen of this number there are records of neurological signs. All these patients, with few exceptions, were seen by myself. In my private practice I have failed to find a single instance of primary anemia of fifty years or older which did not show some neurological signs. In patients under fifty years of age the anemia may be severe and last as long as four years without showing any neurological signs. The first neurological signs to appear in all the primary anemias are the loss of the vibratory sense in the distal portions of the upper or lower extremities and acro-ataxia.

Some of these patients never suffered from anemia. They were not pale, and their hemoglobin during the entire illness never went lower than 75 per cent., and this lasted only a few months. During most of the time there was from 80 per cent. to 95 per cent. hemoglobin (Talquist). The neurological signs, however, progressed just the same as in those patients who were very anemic. They were called primary anemia because they had a venous hum over the bulbus venosus, a high color index, leukopenia, and acro-ataxia and loss of perception of vibrations over the distal portions of the upper or lower extremities. In patients fifty years and older the primary anemia was frequently suggested by the neurological findings. Had it not been for acro-ataxia and impaired perception of vibrations the hematological phase of the disease would have been entirely overlooked.

The fact that the progress of neurological symptoms in primary anemia conforms to those developing in toxic neuritis suggests that the nervous affection in primary anemia begins in the peripheral nerves and ultimately involves the cord. Thus far there have been no histological examinations made which will confirm or deny this interpretation of clinical signs of the disease.